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THE CONTRIBUTION OF SOUND TO ARCHAEOLOGY

Steve MILLS

Abstract: *This paper provides a review of the contribution of sound to our theoretical and methodological approaches to archaeology and for the innovative and engaging dissemination of outputs from archaeological research. By acknowledging the integral role of sound as one of many elements that influence and arise from everyday life, it aims to broaden the scope of our inquiries into the dynamics of past and present landscapes and ways of life. I provide a review of research on music and sound in (pre)history and then a summary of recent auditory archaeology research by the author. I draw principally upon doctoral research in the Teleorman River Valley and introduce ideas from more recent research in the UK, at Catalhoyuk, Turkey and the current Art-Landscape Transformations project centred on the village of Măgura.*

Rezumat: *Acest articol face o trecere în revistă asupra modului în care sunetul poate contribui la abordările noastre teoretice și metodologice în cercetarea arheologică și la o diseminare inovatoare și atrăgătoare a rezultatelor cercetării arheologice. Prin recunoașterea rolului integrant al sunetului, ca unul dintre multele elemente care influențează și care provin din viața de zi cu zi, se urmărește să se extindă domeniul de aplicare al investigațiilor noastre în dinamica peisajelor din trecut și din prezent și în modurile de viață. Se oferă o analiză a cercetării în domeniul muzicii și sunetului în (pre)istorie și apoi o sinteză a cercetărilor recente efectuate de autor în domeniul arheologiei auditive. Principalele idei au fost creionate în timpul stagiului de cercetare doctorală de pe valea Râului Teleorman și introduse în cercetările mai recente din Marea Britanie, la Catalhoyuk, în Turcia și în prezent în cadrul proiectului 'Art-Landscape Transformations' axat pe satul Măgura.*

Keywords: *senses; sound; landscape archaeology; community engagement.*

Cuvinte cheie: *simțuri; sunet; arheologia peisajului; angajamentul comunității.*

1. The significance of sound in mediating everyday life

1.1 Multisensory mode of engagement

The human body is directed at understanding the structure and configuration of its surroundings and does so using all the senses combined. The body has corporeal intentionality by knowledgeably and actively integrating itself with its surroundings (Merleau-Ponty 1962). Everyday experiences of places are multisensual and there are important inter-relationships between the different sense modes that provide people with an understanding of the world around them (Frieman and Gillings 2007). While there are undoubtedly instinctive and universal levels of human sensory capabilities, the learnt, cultural component of sensory acuity is equally important (Rodaway 1994, 22). How the body gathers information about the world is a skill and the learning of these skills is influenced by culture. People from different age groups, genders and socio-economic classes and with different physical abilities can differ greatly in their acuity to particular senses. Furthermore, it is recognised that people at different times and in different places use or define the senses differently (Rodaway 1994, 6). Understanding how the senses gather and structure information about places at any given time must necessarily consider how relationships between people and places and inter-personal relationships are culturally dependent.

Thus, the body has a practical knowledge of the world through the senses. Feld (1996: 91) puts it succinctly: "as place is sensed, senses are placed; as places make sense, senses make place". A fully multisensory analysis of engagement with the world in (pre)history is a vast undertaking. To advance this programme, the present paper concentrates on the significance of sound.

The role of the senses, including sound, for mediating everyday life is now an established area of research in a wide range of disciplines including those in the humanities. Researchers have studied the role of the senses from a variety of different social and historical perspectives (e.g. Corbin 1995; 1998; Classen 1993; Connor 2006; Folkerth 2003; Howes 1991; 2003; 2005; Johnson 1995; Jütte 2005; Picker 2003; Pocock 1993; Porteous 1986; 1990; Rath 2003; Rodaway 1994; Schmidt 2000; Smith B.R. 1999; Smith M.M. 2001; 2004; 2007; Sterne 2003; Stoller 1989; 1997; The Senses and Society journal; Thompson 2002; Woolgar 2006). Examples of research specifically investigating sound originate from disciplines including: acoustic ecology; anthropology; architecture, ethnomusicology; geography; organisational theory; psychology; philosophy; and soundscape and sound art studies (e.g. Augoyard and Torgue 2005; Barac 2004; Blesser and Salter 2007; Bregman 1994; Bull and Back 2003; Carpenter and McLuhan 1960; Corbett 2003; Earlmann 2004; Feld 1990;

1994; 1996; Idhe 2007; Jackson 1968; Kahn 1999; Krause 2002; LaBelle 2007; Nancy 2007; Needham 1967; Panopoulos 2003; Pocock 1989; Schafer 1973; 1977; 1985; 1994; Truax 2000; World Forum for Acoustic Ecology).

1.2 Ecological sound

The places a body inhabits are rarely, if ever, without sound. Sounds exemplify how space and time are brought together. Sound is, by definition, always dynamic, it is created through vibrations and any sound emitted from a source implies that the source is engaged in activity for the vibrations to occur (Pocock 1989). Sound is therefore a happening; it is an event with a specific temporal component. The vibrations of a sound project from their source into and across places and therefore have a spatial component.

Ecological psychology proposes that all organisms, including humans, fit the world around themselves by identifying *affordances* or information (Gibson 1979, see also Ingold 2000). Central to Gibson's theory (1968) is that the places and objects in the world provide people with structured information. The senses in Gibson's model are considered as an entire system or a set of systems that operate through the body as a whole. This integrates the senses, the body and mental processes in the action of perception. The place an organism inhabits is a complex of different kinds of structured sensory information. The environment structures sensory information - sources pass through the environment and are encoded with the structure of that environment- it is a source of information and not a source of raw data. As sound passes through our surroundings it is encoded with information concerning the structure and the objects and organisms contained within.

The auditory system places the body in the centre of activities as sounds reach us from all directions. Our surroundings will often have many sources of sounds that are variously located in relation to the body. The spatial and temporal relationships between different sounds contribute to our understanding of the dynamics, content and configuration of resources in our surroundings.

The geography, ecology and climate of places contribute to what Schafer (1973) terms the vernacular notes of their soundscapes; all places have their characteristic sounding elements. As well as the animals, insects and people that contribute sounds in our surroundings, there are also the physical sounds generated by wind, rain, ocean, thunder, leaves, rivers, seas, oceans, volcanoes, earthquakes, avalanches and floods. Along coastlines there is always the sound of waves against the shore or rocks as well as the many seabirds. There may be many hidden sounds in wooded areas making them secretly busy. In open places, such as open grasslands, sounds maybe few in number and dissipate quickly. Along the course of rivers the sound of water may be ever present. The open valley may dissipate sounds quickly whereas the valley edges may act as sound traps and thus seem more vibrant.

1.3 Sound and sociality

Schafer (1977: 206-7) reminds us that the basic module for designing architectural space is the human body, and for the sounds of architectural places the human ear and voice. The whole human body is involved in knowing places and architecture is known and inhabited by bodies. In outdoor places, before the industrial revolution, there were very few, if any, sounds that interfered with people being able to communicate verbally or that would damage hearing. For most of human history the ear and the voice have been the measure of places in terms of sound. The body anatomy with its sensory systems is the first and best module for designing architecture and Schafer (1977: 217-22) provides examples of how interior places and architectural design have been influenced by the ear and voice in the past. Schafer's (1973; 1977; 1985) concept of the *acoustic community* describes how people can be united and identified on the basis of sound. The church bell when sounding unites the parish and when the bells can no longer be heard a person has left the parish. As Schafer (1985: 89) puts it "bells quite literally gripped the entire community by the ears". Many other examples could be cited of how sounds unite communities; those of domesticated animals and of tool manufacture and use were likely particularly significant in prehistory (Mills 2005a; Mills 2009; Mills and Pannet 2009).

Sounds of many different kinds play an important role in structuring the relations between people and between people and their surroundings. The sounds of the world in which people live are always changing, are dependent on where in the world people live and have changed considerably between the past and the present. There are now many new sounds in the world, particularly since the Industrial Revolution, that have very different qualities and intensities to those of the past. In the modern Western World we are surrounded by the sounds of traffic, car horns, industrial machinery,

aeroplanes and the increasingly ubiquitous sound of the telephone and mobile phone. It is very easy to overlook the important influence of sound for understanding places when surrounded by what is essentially noise; where noise is any unwanted sound (Schafer 1977: 273). The noise of machinery and transport frequently drowns out or masks the information about places contained in other, less monotonous and intense, sounds. It is also very easy to assume that because we in the West do not always acknowledge the importance of sound for everyday life, that this applies to all people at all times and in all places. In the modern Western World places are often *dominated* by sound, whereas in other parts of the world and at most times in the past, sound contributed to the *definition* of places (Schafer 1985: 95).

Sound can provide an important new dimension for thinking about agency and the consequences of social interaction in prehistory. Sounds associated with particular places, architecture and the production and use of material culture influence people in ways that are not necessarily conscious. Although people create and hear sounds through their daily activities and social interactions, they are not always fully aware of the extent to which sounds mediate those activities and engagements. Sounds can immediately alert a person to the presence of other individuals, fauna and resources. On hearing a sound, a person knows that something is happening and probably where it is happening. This may encourage a person to go to that place or avoid it. Sounds communicate information and can initiate response although a response may not be perceived as influenced by any given sound.

1.4 Sensory research in archaeology

This multisensual attitude to the world is starting to be promoted and embraced in archaeology (e.g. Bender, Hamilton and Tilley 2007; Frieman and Gillings 2007; Hamilton and Whitehouse 2006; Houston and Tuabe 2000; MacGregor 1999). The ways in which people engaged with their surroundings in prehistory has been studied most often in terms of vision and frequently from the theoretical standpoint of phenomenology (e.g. Cummings 2002; Cummings, Jones and Watson 2002; Cummings and Whittle 2004; Thomas 1993; 1996; Tilley 1994; 2004; 2008; 2009; Trick 2002; 2004; 2008). Hamilton and Whitehouse (2006) have applied phenomenological exercises including sound at the Neolithic settlement sites in the Tavoliere Plain, Italy. At the sites Hamilton and Whitehouse experimented to discover 'sentient landscapes' by determining the distances over which the human voice and other everyday sounds could be heard, the human body could be seen and smell phenomena could be sensed. These approaches are innovative and inspiring but their application is not without critique (see Barrett and Ko 2009; Brück 1998, 2005; Fleming 1999; 2005; 2006).

The study of sound in (pre)history is gathering momentum and becoming established in archaeological theory and method. The following section discusses some recent approaches.

2. The study of sound in (pre)history

Archaeologists have studied past sounds by examining musical instruments and the correlations between rock art and echoes and the acoustic properties of caves, rock shelters and prehistoric monuments.

2.1 The study of ancient sound-producing devices

The study of ancient musical instruments, or more appropriately ancient sound-producing devices, is referred to as archaeomusicology or palaeo-organology and has been a growing area of research since at least the 1960s (e.g. Cambridge Music-Archaeological Research; d'Errico *et al* 1998; Hickmann and Eichmann 2000-2008; Hosler 1995; International Study Group on Music Archaeology; Kolltveit 2006; Lawson *et al* 1998; Megaw 1960; 1968; O'Dwyer 2004). (The volume of *World Archaeology* 1981 12 (3) is dedicated to the study of sound-producing devices). Related research concerns the origins of music and singing and the development of computer-based soundscape models (e.g. Cross 2003; Cross and Morley 2002; Cross, Zubrow and Cowan 2002; d'Errico *et al* 2003; Mithen 2005; Mlekuz 2004; Wallin, Merker and Brown 2000).

Sound-producing devices, such as bone flutes or pipes, are known from the Upper Palaeolithic onwards and it is likely that the intentional production of sound, beyond that resulting as a by-product of every day activities, was a concern of prehistoric people. Lund (1981: 249-56) has identified four categories of ancient sound-producing devices. Ideophones are those sound-producing devices where the substance of the instrument itself produces sound and includes rattles, scrapers, clappers, cymbals and bells. Membranophones, most usually associated with drums, are percussive instruments that have a covering or skin. Chordophones are stringed instruments including lutes, lyres

and harps. Aerophones are wind instruments including bullroarers (devices swung around the head), conches, flutes, horns, trumpets, bronze lurs (s-shaped conical resonating tubes), reed pipes and the didgeridu. A new area of study, termed lithoacoustics, investigates the potential for lithics to be used for sound production (Cross, Zubrow and Cowan 2002).

Most objects identified as demonstrably sound-producing devices date to the Bronze Age and later. Prior to the Bronze Age bone flutes and pipes are known from the Upper Palaeolithic (d'Errico et al. 1998; d'Errico et al. 2003; Lawson et al. 1998: 113-4). Montagu (1981: 273), in a discussion of conches in prehistory, refers to examples from Hungary dating to the Copper Age and Lund (1981: 255) refers to examples of clay vessels from TRB contexts that are interpreted as drums (see also Wyatt 2008). The recent discovery of a bone flute from tell Hırşova is exceptional (Randoïn et al. 2001).

Research has sought to identify whether objects were actually sound-producing devices, how they were constructed to produce sounds, the kinds of sounds produced and has considered the kinds of occasion during which such devices are likely to have been used. Many studies recognise that the role of ancient sound producing devices was closely associated with ritual or ceremonial performances (see Hosler 1995; Jackson 1968; Needham 1967; Tuzin 1984). While the contribution that sound-producing devices made during prehistoric special occasions is not disputed, there is no reason to suppose that such devices were not part of the everyday lives of people in the past.

2.2 The study of the acoustic properties of archaeological spaces

The study of the acoustic properties of archaeological spaces is referred to as archaeoacoustics or palaeoacoustics (Acoustics and Music of British Prehistory Research Network; Scarre and Lawson 2006). The acoustic properties of ancient enclosed spaces such as caves and megalithic tombs and those of open-air ancient architectural structures such as standing stone monuments and Greek amphitheatres have long been recognised by archaeologists. Such archaeological spaces can produce a range of acoustic effects including echoes, reverberation and resonance that can subtly or dramatically influence how people experience them. People in the past would have been aware of these acoustic effects even if they were not intentionally incorporated during the design and construction phases of ancient structures. A number of published studies have produced results that document the extraordinary acoustic properties of some prehistoric archaeological spaces.

Recent research in caves, at rock shelters, at rock-art sites and concerning 'ringing rocks' or 'rock gongs' in Europe, Africa, North America and Australia provides evidence suggesting that people in prehistory were not only familiar with their acoustic properties but may well have incorporated them when engaged in activities within and around (e.g. Boivin 2004; Boivin et al. 2007; Dams 1985; Devereux 2001; Goldhahn 2002; Loose 2008; Ouzman 2001; Reznikoff and Dauvois 1988; Rifkin 2009). Thus a correlation between the acoustic properties of Palaeolithic caves in France and Spain and the production of rock art has been suggested (see Dams 1984; Scarre 1989; Lawson et al. 1998: 113). Waller (1993a; 1993b; 2000; 2001; 2002), in his research on rock-art echoes, suggests that some within caves and rock shelters produced by clapping, yelling and percussive sounds such as those originating from stone tool production, resemble those of moving animals including bison, horses and cattle. The correspondence between the echoes and the rock art led him to conclude that people were actively reproducing the sounds of the animals depicted in the paintings.

Lynch (1973) suggests that speaking, chanting or making other vocal sounds through openings in the chambered tombs of Newgrange and the nearby Newgrange Site L, may have been considered as a form of communication with the dead and likely to have been both mysterious and profound. From the 1990s onwards a series of more systematic and scientific studies of the acoustic properties of megalithic monuments were conducted. It has been suggested that the resonant frequencies identified within tombs would have enhanced activities associated with chanting (Cook et al. 2008; Devereux 2001; Devereux and Jahn 1996; Jahn, Devereux and Ibison 1996). Watson and Keating (1999; see also 2000) noted that an echo appeared to originate from the recumbent stone at Easter Aquorthies near Aberdeen. Following subsequent investigations, it was suggested that the recumbent setting acted like the stage in a theatre projecting sound across the monument. It was further suggested that as the sound effects were mainly confined to the interior of the stone circle, listeners outside would have remained largely unaware of the audible phenomena within.

Watson and Keating conducted a more detailed investigation at the Orkney-Cromarty group passage-grave of Camster Round in Caithness. Using sound-generating equipment the authors produced standing waves resulting in a series of loud and quiet zones within the chamber. When

moving within the tomb listeners can hear these changes such that the sound is heard to increase and decrease in volume. Furthermore, the source of the sound is often uncertain and can be heard as if within the head. The authors suggest that standing waves can result when the human voice produces a continuous note and are thus well within the capabilities of prehistoric people. The effect produced by percussion within the chamber was investigated and it was discovered that beyond the monument drumming sounded very deep, as if rising from the ground and could be heard over some distance. The authors suggest that the effect produced by percussion could have been exploited as a means of communication between tombs, a possibility advanced for the arrangement and close proximity of passage-graves at Knowth.

Watson and Keating conclude that the acoustic effects demonstrated at Easter Aquorthies and Camster Round may have made an important contribution to the activities conducted at these monuments in the past. In particular they emphasise the difference in potential auditory experiences of people within monuments compared to those who remained outside and stress that this may have enhanced the sense of mystery associated with unseen activities and the treatment of the dead. While the authors state that it is not possible to demonstrate that prehistoric monuments were constructed specifically to enhance acoustic effects, they emphasise that such effects would have been unavoidable when the monuments were in use. Furthermore, they recommend that the acoustic properties of other prehistoric monuments should be investigated as a potential source of valuable new information and that the study of sound should be considered alongside the spatial, visual and structural attributes of archaeological spaces.

The significant acoustic effects of echoes have been investigated at Mayan monuments at Chichen Itza, Mexican Yucatan (Lubman 1998). While there is increasing evidence to suggest the Mayans took advantage of the acoustic properties of monuments, the possibility that such acoustic effects were engineered requires considerable further research.

The studies of ancient sound-producing devices and of the acoustic properties of archaeological spaces have demonstrated the importance of sound as a medium of past social interaction. In addition, they demonstrate that the contribution of sound to the lives of prehistoric people can be studied and produce results that further our understanding of the past. If we are to consider the role of sound in everyday (pre)historic life then alternative approaches are required to complement the valuable research discussed above.

3. Towards an auditory archaeology

3.1 The need for alternative approaches

The success of existing approaches to the study of sound in prehistory is dependent on the presence of well-preserved and specific forms of archaeological material. For example, it requires material culture that can unequivocally be described as ancient sound-producing devices. This is not to imply that the function of all material culture is fully understood and it is certainly possible that clay vessels, for instance, could have been used as percussive instruments as has been suggested for certain TRB vessels (Lund 1981: 255; Wyatt 2008). Without the presence of recognisable attributes such as sounding holes, it is not possible to state with certainty that objects were specifically used to produce sound.

The study of the acoustics and psychoacoustics of enclosed and open-air archaeological spaces demands a high degree of preservation to apply the methodologies employed in caves, rock shelters and ancient monuments. While enclosed spaces existed in the past, (e.g. pit-huts, houses and similar structures), they do not always survive to the extent that a study of echoes, resonance or standing waves for instance could be applied.

To date research investigating the contribution of sound has favoured contexts of social interaction understood as having a ritual character. This is, in part, due to the nature of the evidence available for study. The function of sound-producing devices, particularly percussion instruments, is often associated with ritual or ceremonial performances (Needham 1967; Tuzin 1984). The rarity, elaborate form and context of recovery of ancient sound-producing devices have prompted similar suggestions for the contexts of their use. The evidence for rock art, elaborate architecture and the treatment of the dead in the caves, rock shelters and monuments considered in recent archaeoacoustic studies supports the interpretation that they were regarded as special places by people in the past and associated with sacred activities. Given the established association of unusual sounds and ritual performance, the fact that these recent archaeoacoustic investigations document unusual acoustic effects at such places is perhaps to be expected. This does not detract from the value of such studies, rather it serves to emphasise that the study of sound in archaeology has

hitherto favoured places understood as having ritual significance. Again it must be acknowledged that this is a consequence of the nature of the data. If the only surviving structures are megalithic monuments for instance, they will inevitably provide the obvious target for archaeoacoustic investigation particularly when unusual sound effects have been recognised at these monuments previously.

It is probable that in prehistory there were many cases where ritual and everyday activities were conducted at the same places albeit at different times. Furthermore, the study of archaeoacoustics at many archaeological sites or within the wider surrounding landscape is unlikely to result in the discovery of any unusual acoustic effects of the kind found at caves, rock shelters and extant monuments.

3.2 The aims of an auditory archaeology

The study of the significance of sound in prehistory needs to extend beyond the identification and investigation of sound-producing devices and the unusual sound effects and the kind of places conducive to such effects. A wider range of past social contexts must be included and how the everyday sounds of all prehistoric places provided people with valuable information about the world around them must be acknowledged. This involves a movement away from the abstract physics of sound towards the understanding of sound as acoustic information rather than as acoustic properties. While frequency, amplitude, resonance and echoes are important variables for investigating and quantifying the physical properties of sound and the acuity of hearing, in most everyday situations people do not understand sounds directly on the basis of these variables. When hearing sounds, of most significance is what can be heard, where and when; it is a concern with acoustic information. To study this aspect of sound in relation to prehistory requires an auditory archaeology.

An auditory archaeology acknowledges and studies the role of the human auditory system in gathering acoustic information that both informed and facilitated prehistoric people in the practice of everyday life. It acknowledges that the acoustic information so gathered structures and is structured by people's surroundings and that there is an intrinsic interrelationship between the human body, acoustic information and the places in which people chose to dwell. Furthermore, it emphasises that prehistoric people, through their daily activities, created acoustic information that was integral to the negotiation of social relations. Finally, it recognises that the apprehension of acoustic information need not have been entirely conscious, although there would have been many instances in which it was, and its production and comprehension may have been unintended consequences of particular modes of dwelling.

The next sections provide examples of recent auditory archaeology research.

4. Auditory archaeology in the Teleorman River Valley

Doctoral research in the Teleorman River Valley was conducted in summer seasons between 1998 and 2000 and funded by the Arts and Humanities Research Council (Mills 2001; 2005a). The study area is 10km x 10km centred on the village of Măgura. The study area has three main topographical zones: the eastern valley edge zone, the open valley floor zone, and the river zone (Figure 1). There are three vegetation zones within the study area: the meadow zone, the grassland zone and the woodland zone. The eastern valley edge zone has a meadow/marshland vegetation cover. The open valley floor zone is a largely dry area with vegetation consisting of herbaceous low-lying grassland intersected by sandy areas having little if any vegetation cover. The river zone has a narrow band of meadow/marshland on the banks either side of the Teleorman and Clănița Rivers. There are pockets of woodland within the study area. Up on the terraces there are large areas under cultivation with crops including sunflowers, corn and cereals with smaller plots in the eastern valley edge zone.

The study area includes Boian material culture on raised sandy areas on the valley floor dating between the early to mid 5th millennium cal. BC (Bailey et al. 1999; Bailey et al. 2001; Bailey et al. 2002; Bailey et al. 2003). People were dwelling in short-lived structures on a temporary basis in close association with rivers, were practising animal husbandry and hunting wild animals and were growing and tending crops (Bălășescu 2001; Bogaard 2001; Haită 2001a; 2001b). The commitment to any particular place on the valley floor appears short-lived, a situation which was probably as much to do with river and floodplain dynamics as it was with a desire to maintain mobility as a significant component in the lifestyle.

During the second half of the fifth millennium cal. BC people dwelt and built structures at the eastern edge of the valley resulting in the emergence of tells associated with Gumelnița material culture (Andreescu and Mirea 2008). There are three tells in the study area Vitănești, Măgura and Lăceni. The presence of tells documents a greater commitment to place than was evident on the valley floor during the first half of the fifth millennium cal. BC.

In the present people build and dwell in permanent farmsteads at the eastern valley edge in the villages of Măgura and Vitănești. The commitment to place is greatest at the eastern valley edge because of the proximity of fertile land for grazing animals and cultivating crops. Most activities occur within and around farmsteads and people keep their livestock including pigs, horses, goats, chickens, geese and turkeys in the yards. In addition, most farmsteads have one or two cattle that are taken out to graze on the meadows during the day and led back to farmsteads at night. Plots of cultivated land are maintained by individual farmsteads next to the meadows for the growing of corn and melons in particular.

Out on the open valley floor in the areas of grassland people build only temporary structures usually only lasting for one season or year. The structures are usually made almost entirely of wood although some have corrugated iron panels. Most structures occur on their own and are considerably isolated although on occasion there may be two or three spaced approximately 100m apart. The structures are used by shepherds and pig herders enabling them to remain with their animals at night. For the most part, the only people to be found on the grasslands are the shepherds and herders. The grasslands are reserved solely for the grazing of herds of sheep and goats or of cattle and buffalo.

4.1 Research methodology

Research identified sixteen Global Positioning System (GPS) geo-referenced sound recording stations based on Neolithic activity areas, variation in topography, geomorphology and vegetation, and modern human activities (see Figure 1). Using sound recording equipment primary data was collected at each recording station. Each sound recording was of standard 600 second duration to allow comparison and additional descriptive information was completed on accompanying record sheets. Using computer-based audio editing and analysis software the auditory content of the sound recordings was quantified and integrated in a Geographical Information System (GIS) with topographic, geomorphological and archaeological data sets to identify spatial relationships amongst variables. Based on variation in sound, topography, vegetation cover and the geographic distribution of human and animal activities a number of auditory character areas were identified. Auditory character areas include the eastern valley edge, the open valley floor and the river zone.

4.2 Eastern valley edge/meadow zone

The fabric or texture in any given zone (or place) is an indicator of the density and complexity of activities, of how different kinds of sound interweave in that zone. The fabric is determined by the spatial relationships between different resources and in particular of birds, mammals and the activities of people.

In the eastern valley edge there are many different sources of sound in close proximity, often occurring at the same time, such that the auditory character is consistently busy. The fabric in this zone is dense and complex as the different kinds of sound are tightly woven; it is polyphonic. Where the fabric is polyphonic, people are immersed in many and varied sounds informing them of the close proximity of resources, of animals and of the activities of other people.

The form, or structure, of the composition indicates how the distribution of sound is related temporally in different zones (or places); it provides a sense of temporal dynamics. The form in the eastern valley edge/meadow zone has much variation and contrast and is often lively and fast. The eastern valley edge is a sound trap.

4.3 Open valley floor/grassland zone

The open valley floor/grassland zone having fewer and disparate sources of sound, has a fabric which is loosely interwoven; it is simpler and more porous compared to that in the eastern valley edge/meadow zone. In this zone the fabric is sometimes polyphonic but often monophonic (single source) or homophonic (predominately a single source but accompanied occasionally by others). A fabric of this texture informs people that there is often little happening in the immediate surroundings, there are few birds, animals and other people nearby and therefore few resources and few opportunities for interaction. Sound dissipates easily.

The form of the composition is generally monotonous and slow; it has a low complexity. Apart from shepherds and herders moving and communicating with their mammals, there are few other people on the open valley floor and there can potentially be a sense of isolation and solitude.

4.4 River Zone

An intermediate or heterophonic textured fabric occurs in the river zone where on some occasions it is polyphonic (particularly when people and their animals are present) and at others mono- or homophonic. The river zone is one of medium complexity.

In the river zone the form is more flexible, punctuated, and disjointed. For much of the time there is little variation, it is slow and then intermittently there are sudden or short bursts of sound when people and their animals are present. There is often much sound when rivers are used as resting/watering places. River-crossings are places of transition between topographic and vegetation zones, between meadows and grassland.

4.5 Discussion

The following short discussion provides a summary of alternative ways of thinking about landscapes inspired by the research in the Teleorman River Valley study area.

The concept of auditory character areas provides a new way of conceptualising how sound is integral to people's daily lives and understanding of their surroundings. As people move within the landscape they encounter different auditory character areas dependent on, and configured by, the distribution of topography, flora, fauna and the activities of other people. The composition of auditory character areas is specific to particular places providing people with information enabling them to engage knowledgeably with their surroundings. The composition of auditory character areas may be changeable in the short-term but when returning to particular places time and again certain sounds recur. When hearing particular familiar sounds, people can gauge the resource potential of places.

The association between sound and resources need not be conscious; with familiarity, people become implicitly knowledgeable. As people move between and dwell in different places, so the familiar sounds of those places becomes embodied in their understanding of the world around them. Having heard it all before, people become in-tune with the places they frequent. Through incorporation into particular modes of dwelling auditory character areas become embedded in personal and cultural identities. People who live for long periods of time in close association with domesticated mammals (cattle, sheep, pigs, goats and dogs) in an area of meadows with many birds for example, will identify themselves, in part, with the kind of sounds originating from those animals and a meadow zone.

This applies equally to the built environment. Constructing and living in temporary and permanent architecture are different modes of dwelling and the kind of sounds and identities associated with each will vary. A similar process extends to the different kinds of activities people engage in. Shepherds and herders for example, spending much time alone with their animals and away from the main areas of settlement, will identify with and be identified by, a different range of sounds than people who spend most of their time at permanent structures. With time and familiarity, sound contributes to knowledgeable engagement with the world and the constitution of individual and group identities.

In the study area the sounds of birds and mammals in particular are fundamental to the composition of the auditory character areas. The sounds of birds and mammals are an important dimension in their role as resources. Alongside their role in providing food and secondary products, the sounds of animals is an important resource in itself, and, on occasion, may have been their principal value.

On hearing many birds people may be alerted to the presence of nearby places with good access to water and meadows and thus plentiful resources. The continuous contribution of birds has a significant impact on the composition of auditory character areas in the eastern valley edge, they are very much integral to how those places are acoustically defined. Variation in the contribution of birds during the day is likely to be unconsciously embedded in understandings of daily cycles. Perhaps variation in the acoustic contribution of species at different times of the year is significant in heralding changes in seasonal cycles. Although only a minor element in the archaeological record (see Gál 2007 for summary), birds may have been of major significance in the past for understanding the distribution of key resources, daily and seasonal cycles and in the formation of place identities.

As mammals are less often heard than birds, the value of their contribution may have been regarded higher. Sounds associated with the returning of herds or perhaps with animals in distress,

are important signals and initiate a response. The contribution of mammals is particularly relevant for thinking about the domestication of animal species. With domestication, people develop close relationships with animals; people and animals are in continuous close proximity. People come to understand their animals in part through the sounds they generate and to define themselves in relation to those sounds. In the open valley floor/grassland zone much sound is that of domesticated animals and herders and shepherds understand and communicate with their animals through sound. It is likely to have been similar in the past.

As domesticated animals were most likely highly valued, their sounds would be, at the very least tolerated, and more probably valued. Perhaps the sound of many animals was significant as a signal of success, of wealth or of ownership. This might have applied particularly to shepherds and herders. The more sound from the animals, the bigger the herd and thus the more successful the person. That different domesticated species produce different kinds of sounds may have been significant. As they are larger and require a greater investment in management, hearing a herd of cattle returning from the grazing lands may be more significant than hearing a herd of sheep and goats.

In the short-term, the localised acoustic form at settlements (e.g. tells) varies according to daily and seasonal cycles. It is likely that there would have been longer-term variations in form as settlements went through phases of use and abandonment. It can be suggested that sounds associated with a new phase of tell use and occupancy, because of its very intensity, was significant in constituting part of the conceptual rebirth, heralding the new phase. Conversely, a lack of sound may have been synonymous with, and symptomatic of, a long abandoned and conceptually dead tell. Tells do not start out as tells; they begin as agglomerations of structures and only through repeated phases of dwelling and the superimposition of architecture do mounds emerge. In its earliest phases, the sound originating and propagating from an occupied tell (or more appropriately labelled dwelling place at such a stage in its history) was perhaps a more significant measure of the presence and activities of people than other more visual clues. Only in the more developed stages of its history, when a mound proper had formed, would the visual component of a tell have provided a significant contribution. Therefore, as a measure of monumentality, sound may well have been highly significant at different, and particularly the early, phases of tell histories.

5. Further examples of auditory archaeology research

Following the doctoral research, auditory archaeology has been further applied in the UK, at Catalhoyuk and as part of the EU funded Art-Landscape Transformations project. In the UK the approach has been applied and developed within the post-medieval mining landscape in Cornwall and in relation to Mesolithic flint scatters in Caithness, Scotland and experimentally in south Wales.

The approach was applied to the existing Historic Landscape Characterisation principles developed by English Heritage (Aldred and Fairclough 2003; Herring 1998) within the former (1750 – 1900 AD) tin and copper mining landscape in West Penwith, Cornwall. The approach explored the connection between the more material aspects of landscapes (e.g. physical remains of mining, miners' villages and field systems) and the less tangible components of place, specifically sound. The author had been a team member during the bid to make Cornish Mining a World Heritage Site (now inscribed) and it was recognised that sound could contribute further to the the many and varied approaches for the presentation of mining heritage. This work incorporates the concepts of anthrophonies, biophonies and geophonies to categorise and represent sounds based on those produced by people, animals and vegetation and the physical environment respectively. A website was developed to present the research to a wide audience and integrates GIS mapping with audio-visual multimedia (Mills 2005b).

Further examples of auditory archaeology research in the UK considered the influence of sound during flint tool production and use to expand the theoretical and methodological approaches for the study of Mesolithic flint scatters (Mills 2009; Mills and Pannett 2009). To move research beyond the more traditional typological approach to flint tools and debitage, this research considered the social implications of the sounds produced when working with flint. It emphasised how the consideration of other aspects of flint use including sound, can lead to alternative and novel ways of thinking about the interactions between people and materials, of social relations and community identities and of differing perceptions of the landscape.

Studies at Catalhoyuk initially centred on the reconstructed experimental house to explore the acoustic properties within domestic spaces (Mills 2005c). The experimental house had been previously constructed informed by the ground plans, dimensions and materials recovered during the

excavations of Neolithic structures at the site. With the support and guidance of site specialists (Mirjana Stevanovic, Ruth Tringham and Ian Hodder) acoustic experiments were conducted within the experimental house involving a range of different tasks and different participants. To get an idea of the acoustic properties of Neolithic houses, tasks included cleaning, sweeping, plastering, cooking, singing and grinding. The acoustic experiments were recorded and later used to add a dynamic audio component to the presentation of the house to visitors. Following from these preliminary experiments, further work at Catalhoyuk with Ruth Tringham considered the role of new and emerging digital media for the presentation and interpretation of archaeological sites (Tringham et al. 2007). In particular, this emphasised how data collected during archaeological fieldwork (e.g. paper records, photographs, video, sound recordings, databases) can be re-combined or 'remediated' in many and different ways to broaden the means by which heritage is presented enabling the potential to appeal to wider audiences.

Embracing new technologies and widening the theoretical and methodological approaches to the study of the past, such as by more fully integrating sound, opens up new possibilities for research and, equally importantly, for engaging new and wider audiences. Engaging communities with their local heritage is at the heart of the European Commission funded Art-Landscape Transformations project (see Trans Form Actions website). One of the scenarios in this project is centred on the village of Măgura and engages participants from the village with archaeologists and artists in a range of activities, including workshops, exhibitions and conferences, exploring different aspects of local heritage and its relevance to different people. Sound recordings of project activities, of village life and from the surrounding landscape contribute to this project providing media to enhance exhibition spaces and web-based applications including Google Earth and as outputs in their own right (Figure 2). By integrating a wide range of different media outputs, including photographs, paintings, sound recordings, paper-based and online publications, the relationships people have with their surrounding heritage can be explored and presented in new and more engaging ways.

6. Conclusion

The senses, including sound, are an integral component in the ways people, both past and present, negotiate everyday life and understand their surroundings. By integrating sound in research agendas, archaeologists can drive forward studies of the past and explore new and alternative means of engaging different audiences with heritage. As discussed above, the aim is not to provide a single definitive approach, but to seek theoretical frameworks and methodological techniques appropriate to the research questions, geographical locations, archaeology encountered and audiences considered at any given time. By introducing and summarising recent and ongoing research, it is hoped this paper has gone some way to promoting sound as having the potential to provide innovative ways to further heritage studies.

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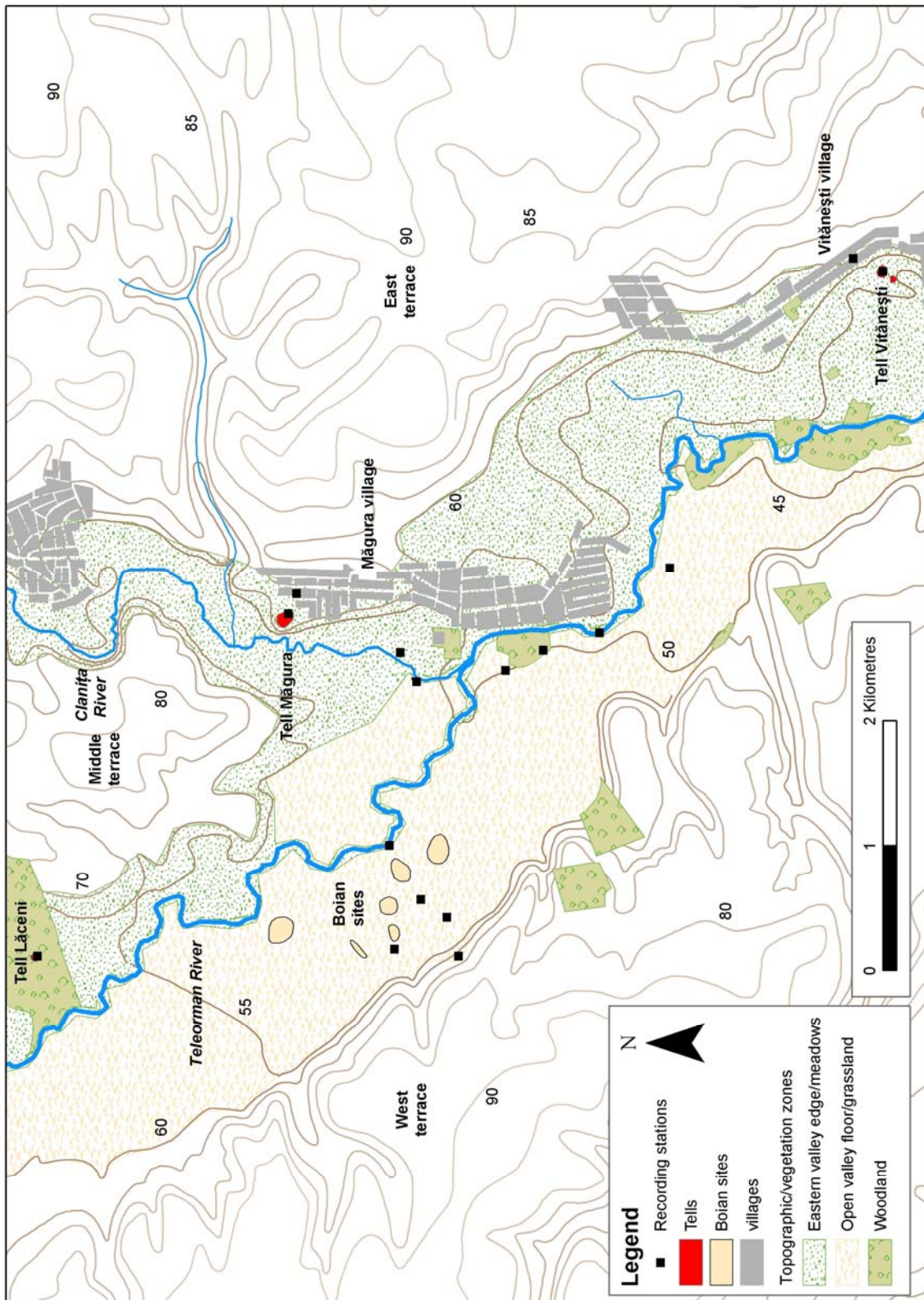


Figure 1 Map of the study area showing topographic/vegetation zones, rivers, villages, Boian and Gumelnița sites and recording stations.

Harta zonei analizate cu detaliile topografice și ale zonelor de vegetație, râurilor, satelor, siturilor arheologice Boian și Gumelnița și amplasarea punctelor de înregistrare a sunetului.

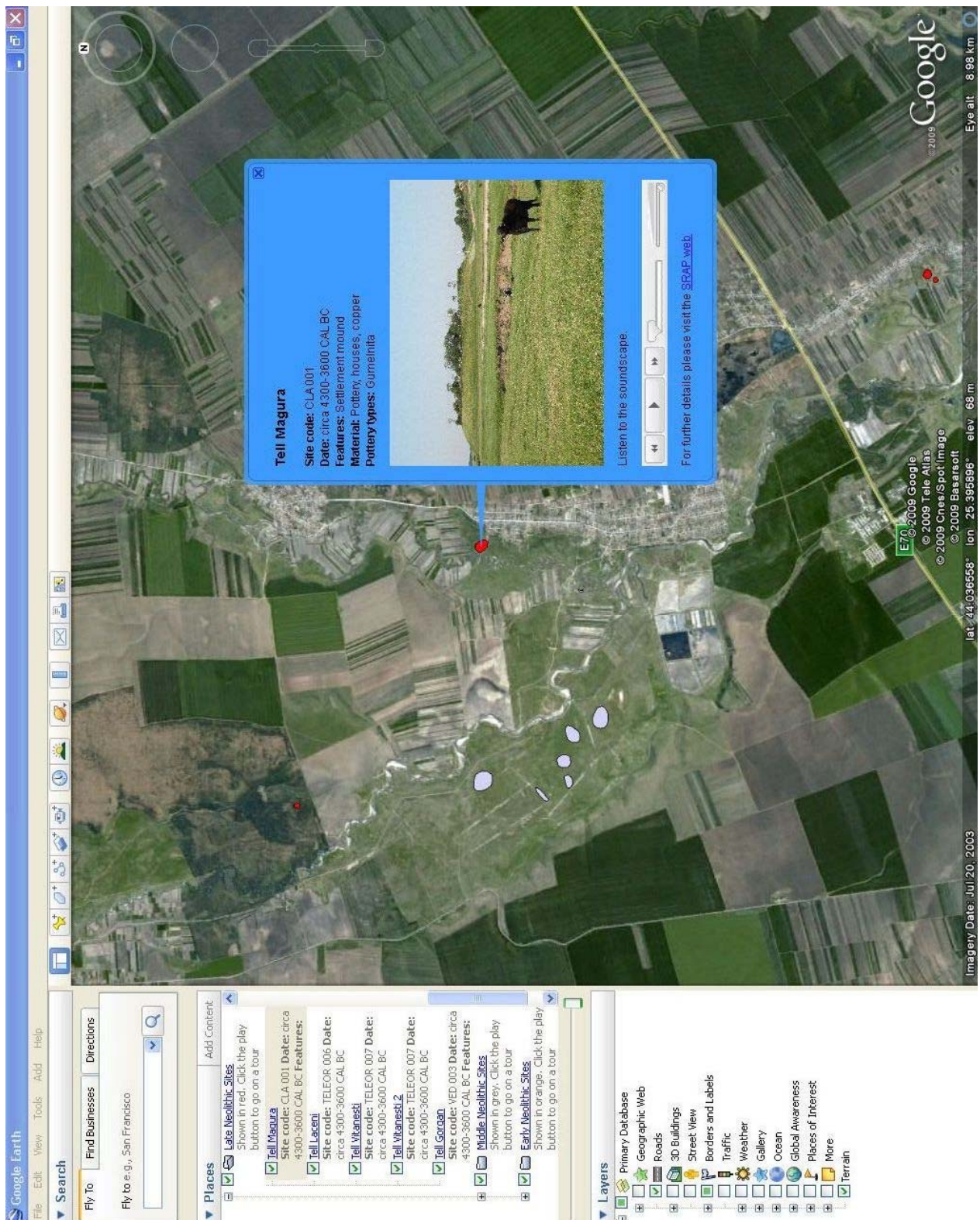


Figure 2 Example of project output using Google Earth showing multimedia representation of Tell Măgura including a sound recording of the local soundscape.

Un exemplu de diseminare a proiectului, folosind site-ul Google Earth pentru a ilustra o imagine a *tell*-ului de la Măgura, inclusiv o înregistrare a peisajului sonor local.